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INVESTIGATION OF ANTARCTIC CRUST AND UPPER MANTLE USING MAGSAT AND OTHER GEOPHYSICAL DATA

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(E82-10147) INVESTIGATION OF ANTARCTIC CRUST AND UPPER MANTLE USING MAGSAT AND OTHER GEOPHYSICAL DATA Quarterly Status and Technical Progress Report (Wisconsin Univ.) 6 p HC A02/MF A01 CSCL 08G G3/43 Unclas 00147 N82-21674

Since the last MAGSAT progress report (9/9/81) we have continued analyzing the MAGSAT data over Antarctica. Ritzwoller attended the Midwest A.G.U. meeting in Minneapolis on 9/18/81 and delivered a paper entitled "Preliminary MAGSAT Investigations over Antarctica" (authors: M.H. Ritzwoller, C.R. Bentley, and L.L. Greischar). A paper has been written and is currently being reviewed for inclusion in the MAGSAT edition of Geophysical Research Letters. The title of this paper is "MAGSAT Investigations over Antarctica and the Surrounding Oceans" (authors: M.H. Ritzwoller and C.R. Bentley). Finally, an extended abstract entitled "MAGSAT Studies over High Southern Latitudes" (authors: M.H. Ritzwoller and C.R. Bentley) was submitted for inclusion in the volume associated with the NASA Geodynamics Meeting in January 1982. A brief summary of our work follows.

It is very difficult to filter auroral external fields from the MAGSAT data to isolate the crustal magnetic anomaly field. Field-aligned currents in high latitudes and magnetospheric ring-currents in equatorial regions both contaminate the MAGSAT data. The slowly-spatially-varying ring-current fields have been modeled as a quadratic least-squares fit to each pass over Antarctica. Modeling field-aligned currents is harder so we have attempted to delete all passes showing their effect by requiring all passes used as data to satisfy two selection criteria: the planetary magnetic activity index, K_p, must be less than, or equal to, 1^- for 6 hours and all anomalies must have amplitudes less than 15 gammas (Fig. 1). Of the approximately 3000 passes over Antarctica between November 1, 1979 and April 1, 1980, the 87 meeting the selection criteria can be seen in Fig. 2 and have been used to construct the scalar magnetic anomaly map for regions south of 55°S latitude (Fig. 3).

The temporal stability of anomaly features is a necessary, though not sufficient, characteristic of fields generated in the crust. Tests performed internally on the MAGSAT data and comparisons made with the POGO map indicate that the general anomaly features are stable over the past 10 years, consistent with the belief that they are of crustal origin.

The sources of anomalies generated in continental and oceanic regions are different. It is believed that the sources of continental magnetic anomalies are located principally in the lower crustal layer above the Curie isotherm so that regional heat flow greatly affects the thickness of the magnetizing layer, and that remanent magnetization has little effect. On the other hand, the highest susceptibility layer in oceanic crust is near the surface, generally well above the Curie isotherm, so that regional heat flow only affects anomalies in exceptional cases. Furthermore, we believe that near ridge crests remanent magnetization contributes to magnetic anomalies at satellite heights.

The correlation between the crustal magnetic anomalies and known geologic features is surprisingly good over both West and East Antarctica and over the surrounding oceanic regions. Correlations are noted between magnetic anomalies and mountain ranges, subglacial basins, tectonic provinces, regional gravity anomalies, a hypothetical continental rift feature, oceanic basins, and oceanic rises.

Research in the next few months will include the improvement of the field-aligned current filter and the map generation process in general, the creation of crustal anomaly maps for southern continents to test Gondwana reconstructions, the investigation of magnetic anomaly highs associated with oceanic ridges, and tests to determine the anomaly "signature" of field-

aligned currents using vector magnetic data. Also, we hope to develop a three-dimensional method for inverting magnetic anomaly data to average regional susceptibilities and average depths to the Curie isotherm. Since regional estimates of crustal thicknesses are few and tenuous over Antarctica, such a method applied to MAGSAT data could lead to a new understanding of the structure of Antarctica as a whole and perhaps could illuminate the only dimly-known tectonic relationship between East and West Antarctica.

November 30, 1981

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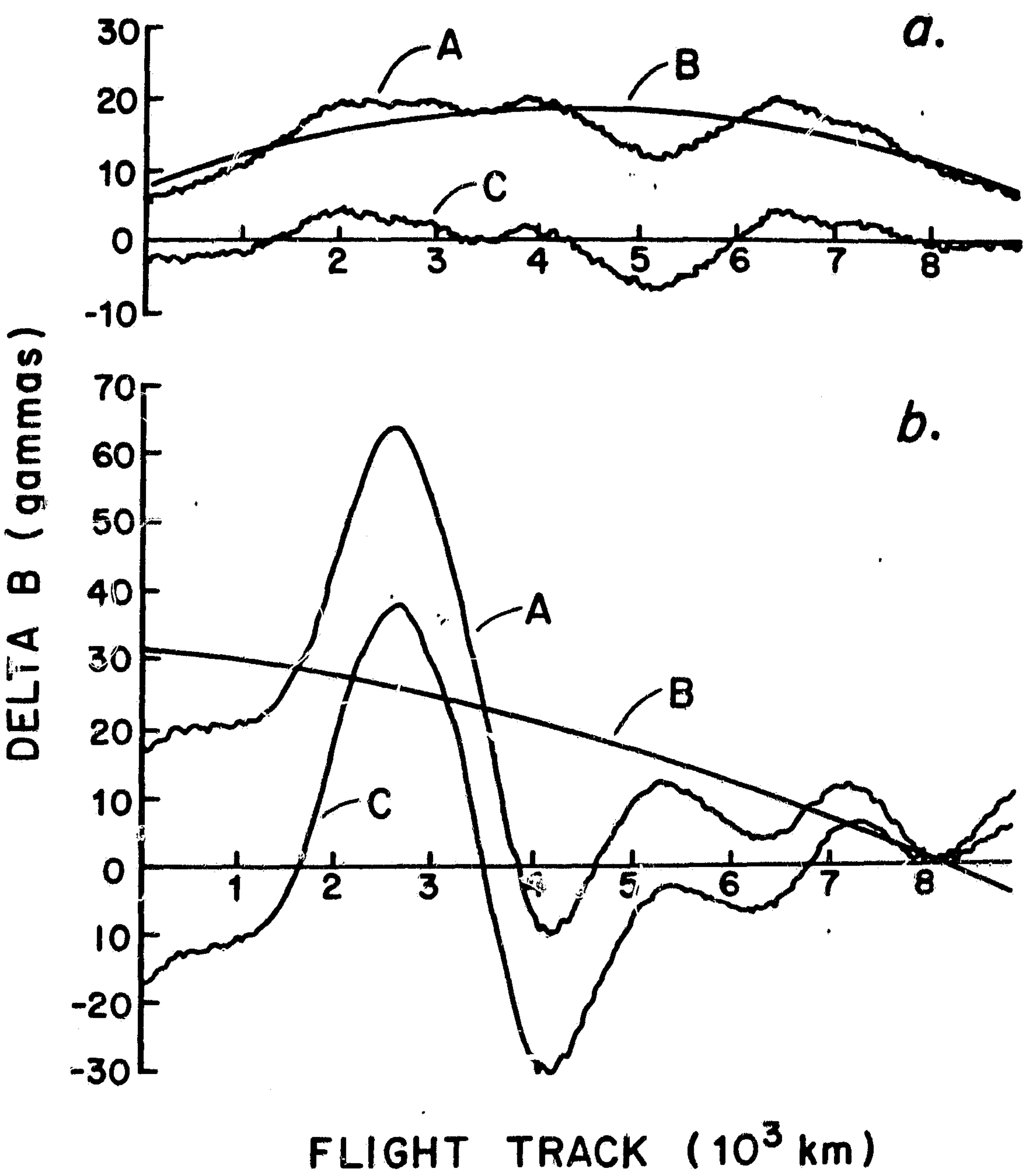

Figure 1

Graphs of magnetic anomalies for: (a) a pass unaffected by field-aligned currents, and (b) an affected pass where A is the total-field minus the core field model, B is the quadratic polynomial model of the magnetospheric field, and C is A minus B, i.e. ΔB.

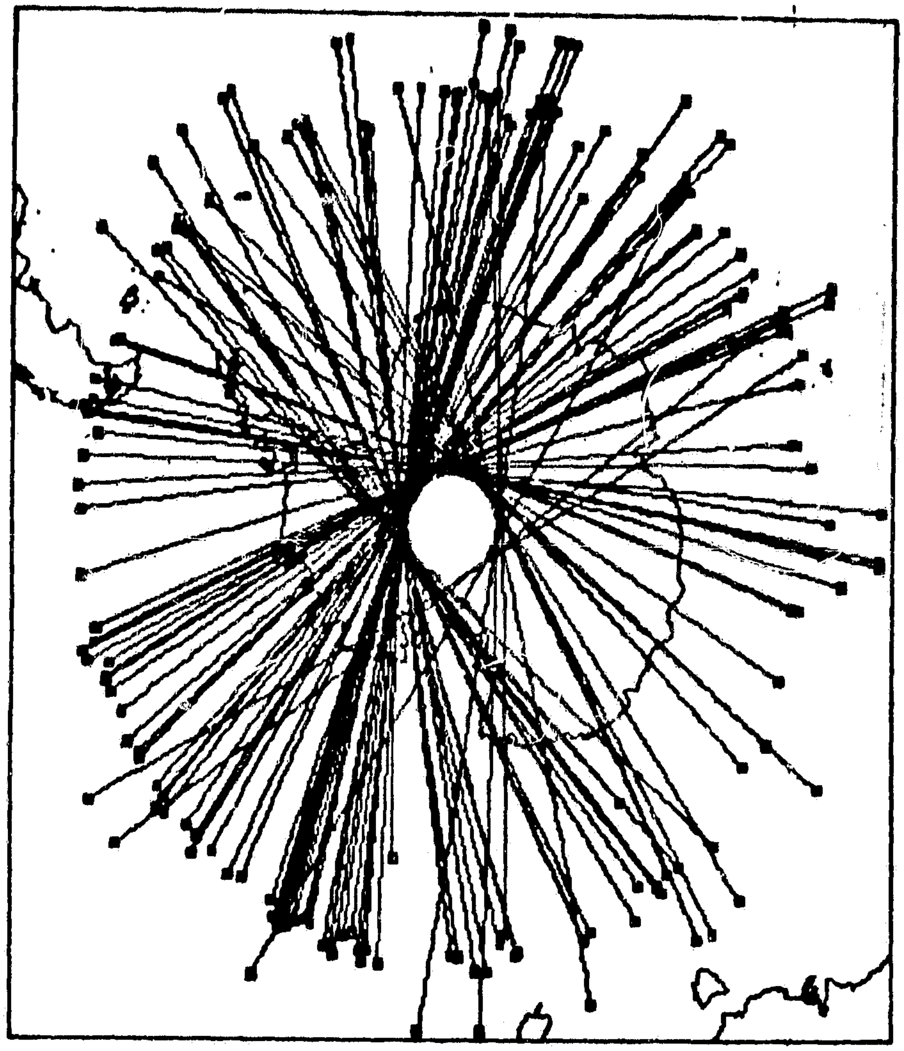

Figure 2

Flight tracks of the 87 passes over Antarctica and the surrounding oceans.

Figure 3

MAGSAT Antarctic magnetic anomaly map.